BIO-DYNAMICS

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THE BIOLOGICAL BALANCE

E. PFEIFFER*

"Humus began to dwindle when farming products became a merchandise." Thus spoke Thaer, *the father of humus management,* over a hundred years ago. What he meant with regard to farm products becoming merchandise is simply that when Mercantilism entered the farming picture, the art and skill of farming became a matter of calculation, of an emphasis on balance sheets. Agriculture became increasingly a matter of weighing income against expenditure, feed against production in both the soil and the animal realm.

However, if the economic equation, which is like any other equation, has too many unknowns, the possibility of arriving at a balance of one's books becomes less and less attainable.

What do we find if we look at a farm from this point of view? People tend to think that if they have bought, or inherited their land, implements, house, buildings, etc., and list these against debts and their running expenses for labor, feed, seed, fertilizer, depreciation and interest they can set up farm books that are accurate. It would appear that everything you can buy and everything you can sell is a merchandise.

But there is an important factor standing in between the income and the outgo side, something that you cannot buy or sell. This is, the fact that things **grow**. *Life* is something that cannot be bought or sold, it can only be fostered or destroyed. The way things grow on your place is the fruit of your way of working, of your method, in the final analysis it is the product of your thinking. Neither can you buy *health,* nor, in the human realm, can you buy *happiness.* Here, since we are discussing the realm of life and growth, we might better substitute a more strictly biological term, *satisfaction,* in this case "biological satisfaction". This latter has an important bearing on the success or failure of our farming, since a plant also knows satisfaction (not emotional, of course, but biological), if it is properly grown, rightly nourished. An animal knows the same biological satisfaction—or its opposite—and it has, in addition, also the possibility of emotional satisfaction. This state has a real relation-

*From a lecture given at the B. D. Conference, Spring Valley, July, 1955.

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ship to the success or failure of our farming. We need only recall the relatively higher production, cow for cow, of the old-fashioned "family cow" as compared with a component of a modern "milk factory", of similar physical capacity.

Upon this biological *satisfaction* and *health* there actually depends the farm yield and the ratio to it of the running expenses. Thus on a biological basis the economic balance is determined, i.e. the profit and the standard of living one can achieve upon a farm. The yield also depends on the climate and local weather, the water supply especially; factors which are not entirely under control of the farmer.

So we have to speak of the biological balance before we can legitimately get into the book-keeping that can show us the economic balance.

The troubles of the farmer in our time have arisen because we think in terms of the economic balance only and have forgotten about taking into consideration the biological balance, that is, all the things one cannot buy, which, however, one needs for growing crops.

What, then, is this biological balance?

Before entering into this problem in more detail, I would like to direct a question to the reader: What is the *largest crop* we raise on our farms today, the biggest in terms of money value and of expense to the farmer, and yet totally unmarketable? One might at this point stop reading for a moment, and answer this question for oneself.

The crop to which I refer consists of *insect pests, fungus and virus diseases and weeds.* Annually, these destroy $5,000,000,000 in crop values. Also, they cost the farmer tremendous sums yearly in outlays for insecticides, pesticides and weedicides, and the labor to apply them.

The fact that the expenses for these items, relatively nonexistent for earlier generations of farmers, have increased from year to year in recent decades is a direct outcome of our "economic" thinking in farming. Previously the farmer's basic concept and operation was one of self-sufficiency, of self-sustenance. He had a diversified farm management and rotation. Now he grows for cash crops within the limitation of the soil. The maintenance of the fertility idea is pushed back in favor of the production idea. Before Thaer and his concept of humus management, the farmer did not buy either fertilizer or insecticides and pesticides. Now, of course, he does, and this adds heavily to his

expense account. Everybody except the farmer is rather happy about this, especially—for a while at least—the manufacturer of these materials.

In bio-dynamic farming I realize, and know from experience, there exists one of the most important factors by means of which I can survive the economic squeeze. I mean: if I do it correctly I can avoid or practically avoid, buying these above-mentioned materials, because a biological balance is aimed at primarily.

In order to achieve this, however, I have to raise the level of health and biological satisfaction of my plant and animal crops. That is, I have to attain *the biological balance*, because health, life and growth are in fact identical with this biological balance.

In one pan of the scales of this "balance" we have the materials, in the other the energy for growth. The materials of the plant are soil minerals, water and air. It consists of from 2 to 10% mineral matter, and an average of 80% water—though this can fluctuate between 60 and 95%. It contains on the average 20% air, varying between 5 and 40%. In the air are present also oxygen and carbon dioxide, two important plant foods which we never buy.

The energy for growing is the light, and the climate (i.e. the distribution of warmth and cold and rain). This we don't buy, but unless it is properly worked in, is correctly made use of, the load in the other pan of the balance is valueless to us.

One of the great differences between the inorganic mechanical realm of technology and the use of a living biological system is in the relationship between assets and liabilities and the depreciation of the means of production. The difference in the latter is even acknowledged in a way by the tax laws, namely that no depreciation for the land is allowed.

Theoretically, if no depreciation for the land is allowed this should remain eternally in good productive condition. Otherwise the cost of production, expressed in the need for supplements (fertilizers, etc.), will grow from year to year.

In the use of machines and factory or farm buildings it is obvious that the means of production wear out and have to be replaced. Depreciation is, properly, reckoned in.

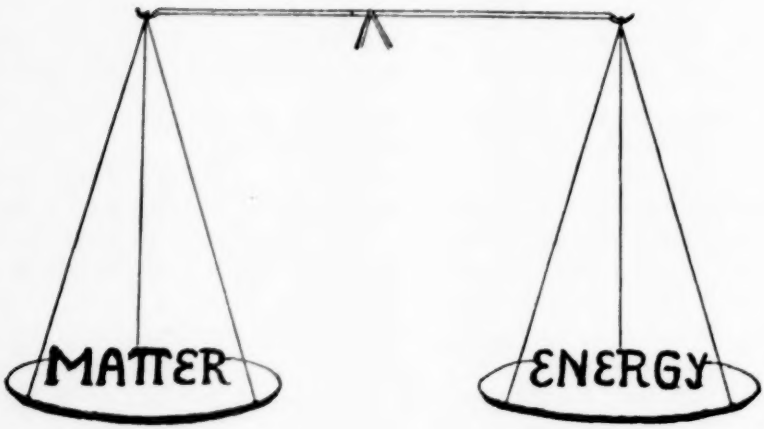
The soil is a living, biological system and has to be maintained. It is in a way self-reproducing—seen as a biological entity —like an animal or plant. Self-regenerating would perhaps be a better term. However, very few look at the problem from this

angle. So the land is run down and it is thought that fertilizer (a running expense) can correct the situation. This is a great biological error, as history as shown. After the land is run down it costs more to rebuild than it is worth. Run down land changes from an asset to a liability. It is of utmost importance for the farmer and for the economic situation (with a view to profitable management), to know exactly when this borderline is passed. With the land becoming a biological liability, peasant farming ends and the growth mechanic can continue for a while until his production cost becomes uneconomical.

The same point of view applies to livestock and plants. Health, that is a normal reproductive cycle without degeneration, is an asset. Diseased livestock, weak plants reproducing in inferior fashion and over-run with insect pests, become liabilities and therefore increase reproduction cost. We have therefore two balance schemes, two scales: one for the biologically well maintained, healthy situation, another for the diseased, mechanical, wear and tear balance system. The cost of production of these two different schemes is entirely different. The present age veils this problem. In fact one is almost forced to think of blinders or the ostrich policy, when one wants to approach the problem openly and consciously. Part of the web of this veil consists in the factor that the farmer gets less per working hour and works more hours a day than any industrial laborer. If the farmer would strike and demand higher wages and less hours—we would like to see the uproar. It is however in the nature of farm business that he cannot strike and pour the milk down the drain or withhold products from the market. He can only engage in passive resistance as the Russian peasant did to the communistic system, or sell out as many an American farmer did.

In the following sketch of balances this point of view of a biological and mechanical system is expressed, hence we have soil fertility and state of health as an asset in one case, as a liability in the other. By no means do we imagine that these sketches are complete. The aim is only to give a basis for further thought.

Biological Balance



Soil:
Natural supply—asset
Natural fertility—asset
Run-down soil—liability
Given mineral supply—asset or liability
Given organic-humus supply—asset or liability
All costs of improvement, correction, added running expense
Given water supply by nature — asset
All corrections of shortage or overabundance increase cost. It should never be forgotten that water is the most important limiting factor
Air: Oxygen, nitrogen, carbon dioxide. These are apparently given by nature. However, the management decides whether the best use is made of them, f.i., in a well-aerated soil there is nitrogen fixation by microorganisms. Lack of air in the soil means need of drainage, cultivation, and increases production cost. Lack of nitrogen fixation forces one to increased fertilizer use, i.e., costs money.
Seed: quality and viability

Light
Warmth
Climate
Fuel
If one has to buy any energy it costs money, f.i., light and heat in the greenhouse. These are delivered by nature free of charge in normal farming.
However, the field of making these energies more efficient remains yet to be explored.

The proper balance between *all* factors means: State of Health.

Mechanistic Balance

Asset	Liability, and/or running expense
Soil, as is, water, air, climate, natural state of fertility, humus and fertility—maintaining practices. Applied and effective soil conservation.	Work on the land
	Fertilization
	Improvements and correction of deficiencies
	Diseases and their cures, losses on account of diseases.
	In general, health measures.
	Every shortcoming becomes a liability.
Efficient use of all means of production, buildings, machines.	Inefficient use of any means of production.
Value of farm (purchase and production values may be different).	

Economic Balance

In	Out
Yield per unit.	**Labor cost:** wage level determined by general economic considerations, quality of labor and efficiency of management decisions.
Sales price, or value if used on the farm itself, f.i., for feeding, manure, green manuring.	**Machines:** running expenses, fuel, repairs, maintenance, depreciation.
Efficient use of machines, tools, labor.	**Feed:** produced or purchased, good quality of feeding reduces cost.
Efficient management.	**Buildings:** repairs, maintenance, depreciation.
	Overhead: taxes, insurance, electricity, telephone, etc., etc.
	Expenses for health: veterinary, medicine, sprays against diseases and pests. Poor seed. Loss because of poor health.
	Fertilizer: any supplement, and basic fertilization.
	Seed: any.
	Livestock: selection of optimal production type.
	Other: not specified here, miscellaneous.

On the *matter* side of the biological balance we are faced with a number of choices between using what nature provides or laying out cash for substitutes. Thus in regard to the soil we can figure on 2,000,000 to 4,000,000 pounds of mineral mass in a top soil or we can spend money (for which we have to grow crops to get it) for anywhere from 100 pounds to 2 tons per acre of mineral fertilizer, including lime. For our trace minerals we may rely on composting mixed weeds—rich in these materials—or buy 1 to 20 pounds per acre to attain the optimum ratio of 1 to 20 parts per million of the trace elements.

Water, if we locate in a region of adequate rainfall, will again be available from nature; it is important to recall that the moisture a crop gets is what determines the yield, moisture is the limiting factor *not* the fertilizer. To buy water by way of irrigation runs, as is well known, into money.

Again, the access of air can be a very expensive item if we figure up the labor costs of cultivation, f.i., in order to get a well-aerated soil. All organic matter in plant life derives from the carbon dioxide of the air. This we don't buy. But carbon dioxide can be greatly increased and made available by the microlife in soil and it can be preserved and retained by proper cultivation and such items as windbreaks. This a farmer could control to a certain extent if he were only conscious of it.

On the matter side we must also include the seed and seed quality, and the livestock and its basic quality. Feed, housing and fencing for the stock also come in here.

In the other pan of these metaphorical scales we must reckon, as has been shown in the diagram, Light and Warmth. Anyone who has operated a greenhouse knows that if you have to buy warmth, this is very expensive indeed. If you would have to buy light for your crops it would be so expensive that you could not afford it. In certain instances, such as light for your chickens to extend the day in the laying house, you do, of course, buy light, but this is a specialized situation.

However, the farmer nowadays is buying a lot of energy in the form of mechanical energy to work and move his machines. The more of these machines, the more the expenses.

Mechanizing the farm as far as individual circumstances dictate is not only legitimate but necessary in order to increase production so that the economic balance may be on the plus side. But it is increasingly important, with increasing mechanization, to work on a foundation of biologically sound practice. Otherwise one will be merely increasing the production of diseased organisms, pests, etc., crops that will definitely not bring in more cash.

As for the *biologically important* items, on both sides of the biological balance, the practical reality is: *it is more costly to buy rather than to raise them.* Because: health, resistance, cannot be bought. It can be raised or maintained. Only remedies can be bought. But a remedy is not health. Deficiencies also should be looked upon as "disease"; the fertilizer or additional feed concentrate in order to grow more is a remedy, if you have to buy it you have to spend a lot more money.

This brings us back to a statement I made in print some 20 years ago:

That which is biologically correct is also economically sound. It was on the basis of this fact that I myself—after I had learned

something of farm management—dared to buy a farm with, practically speaking, no money, and was able to make it succeed by working it along bio-dynamic lines. Specifically, I was justified in the venture because I knew I could save expenses by attention to those items which cannot be bought: Health and biological satisfaction for the plant and animal crops.

Let us now look at the economic balance in a very realistic way, in terms of money saved or not saved in accordance with the use or non-use of sound biological practices:

On the "IN" side we must put *Preparation of the land.* Doing this in the biologically best way can save lots of expenses and untold disappointments. The question is not merely "Am I efficient?" It is a matter of whether my work on the land creates healthy conditions for the crops. The outgo here is chiefly for labor and for machines. Labor costs will be determined by general economic conditions. These are not under my control—that is, the level of wages. The amount to be spent for labor can be under my control. My only self-protection here is that poor labor can be fired. Whether the replacement will be better is, of course, the $64 question. Regarding machinery I must ask myself whether its use is, in each case, not only labor-saving but biologically justified—for instance too heavy machinery, big tractors, used on small fields as described in my last article, certainly do not only consume gasoline but pack the ground.

Sound cultivation practices (for instance, knowing *when* to cultivate) can give *increased yield without depletion* of soil or of the inter-related health factors. Thus I can save here on the not inconsiderable fertilizer bill if I work my place on b.d. lines. The cost of insecticides can be kept to a minimum if one follows biologically sound practices.

Another book-keeping item of importance, as the years of practical experience have shown, is that savings can be made on the veterinary and veterinary medicine bills by feeding livestock on a biologically sound basis, for instance not to force too high a production and hence not having too rapid a turnover among dairy cows. Increased production has an optimal limit which is by no means identical with the top limit. To find the proper balance here constitutes the art and skill of livestock management. One can prove from the farm books that what is to be aimed at is *optimal balanced production,* not raising production to the top level that might be possible for an animal for a limited time. In the horse and buggy age one knew very well how much load and

labor a horse could take. Today in the age of the balance sheet one does not, in feeding, ask the question: how much can an individual cow take, but just forces her to the limit of production. The forced cow will answer with increased breeding trouble, udder diseases, brittle bones, finally sterility. "Why is it always the best cow which gets sick?" is a question that many a farmer has asked.

All of the foregoing is related to the basic question: Can present farming methods survive in our economy?

The Congressional Representative from our area recently told a farmers' meeting that "the family farm" is on the way out. In other words, the old, truly skillful peasant farming is a thing of the past. The small farmers that are still hanging on tell us the same thing. In fact, the evidence from all over the earth seems to corroborate this. The peasant farmer is being replaced by the "growth mechanic".

But growth, as we have seen, is not a mechanical problem. It is logical that if we think only of the mechanical-economic approach, we have to arrive at specialization and monocultures. These will increase because they lend themselves better to rational management than does diversified farming.

Some monocultures can be made biologically sound: for instance, grassland farming, citrus growing, tropical cultures such as sugar cane, *provided that in each instance the humus management is maintained.* Even market gardening can operate on this basis if the humus management is sound.

I can conceive of the farmers linking their operations, along these lines, on a nationwide basis that includes such specialized cultures, provided always that the practical emphasis on a sound soil and humus management is kept in the foreground.

Monocultures devoted exclusively to grain cannot be maintained. Here diversification—with green crops and legumes—is a must.

Yet if this goal, of rational management that includes certain biologically sound monocultures, is to be reached, we have somehow to *change the mentality of the economist* so that his thinking and his practical planning *include the biological concept.*

Further, the farmer himself will need to change his mental outlook, and not merely in the direction of biological thinking and humus management. We need, as farmers, to think and work in terms of diversification on a large scale, not merely 5 or 20 or 40 acres of one crop on our own farm, but—to express this in a

picture—county- and soil- and climate-wise diversification, while maintaining the humus and biological aspect as the PRIMARY Concept.

Let us consider as an example Mr. Stuber's poultry farm, as he reported on it at this year's B. D. Conference. He grows all the feed for his chickens, yet there is no reason why, under a wider diversification and specialization as suggested above, he or any other poultry farmer should not buy supplementary feed from another farm so long as he is still provided with biodynamic feed for the chickens and the chickens get some range pasture.

Of course the chicken farmer should keep his flock on a biologically sound basis, by healthy breeding practices and other measures. To bring this about, another new "industry" has to develop. Chickens were healthy (essentially disease-free) when they were allowed to run about and scratch on the manure pile and in the soil. This was because of the growth factors (hormones) they obtained in the manure, and the earthworms and natural antibiotics they got from the soil. So there could be a new industry providing manure, earthworms and other supplements for the chickens, as well as the alfalfa meal now so marketed. Day-old chicks should be provided with sand, chopped stinging nettle and camomile tea.

But, we will be rightly told, the chicken farmer's immediate need if he is to stay "in business" is an increase of production. Well, there was a B.D. chicken farm in Holland whose hens had a top production of 265 and an average of 245 eggs a year.

We would use incubated baby chicks on our "rationalized" chicken farm, but only from eggs produced by hens and roosters which had natural, outdoor pasture. The result would be: reduced diseases, no inoculations needed.

As soon as one moves away from nature one moves away from health, and one has to "buy" something, a substitute for nature's balances. This must always be kept in mind.

How does the biological approach work with cattle? Our experience has proved that proper pasture and hay-feeding enables one to get optimal yields—even without additional grain feeding. Raising alfalfa with 24% protein and hay with 18% protein, one does not need to buy mixed concentrates. This goal has been reached abroad but rarely ever here.

I believe that we can survive, that is, become in fact independent of the fallacy of a mechanistic economy, if we introduce

biological economy and balance. It is probably unavoidable that we have some diseases and some malnutrition. The question is: Can we survive or do we create soil conditions of such a kind that the progress of disease outgrows and outweighs the factors making for health? The answer to this basic question is a matter of the human attitude.

REAPPRAISAL OF TODAY'S NUTRITION

W. CODA MARTIN, *M. D.*

This interesting paper on the food question is from a lecture given by Dr. Martin in April of this year at a meeting of the American Academy of Nutrition at Long Beach, California. The material is to appear in a forthcoming number of the Journal of Applied Nutrition.

The general public believes that the United States is the best fed nation in the world. There is no question that we have an abundance of food per capita, and it can literally be said that "we are living off the fat of the land." But is the food that we are consuming the proper food for good nutrition and good health?

Let us look at the record for the answer to this question.

In the United States, the standard tables of food consumption list only *89* plant foods, while in Mexico and Central America scientists have collected and analyzed *224* different varieties of plant foods. Many are higher in nutritional elements than some of our foods. But the number and variety of plant foods is not the answer, as a further look at the picture of nutrition in the United States versus other countries, shows:

First—recent studies by the Massachusetts Institute of Technology sponsored by the United Fruit Company reveal that, despite their poverty, the humblest Indians in Central America suffered less from malnutrition than the average middle class family—presumably well fed—in the United States.

Second—a specific study of 1,000 Mexican school children in one of the poorest districts of Mexico City showed less evidence of nutritional deficiencies than did a group of Michigan school children.

Third—another study has revealed that European school children have greater physical endurance than children in the United States of the same age group. The studies (all groups) of the muscular fitness of American school children revealed that

56.7% between the ages of six and nineteen failed to meet the minimum standard required for good health. Whereas, in the European countries studied—Austria, Italy and Switzerland—the figures averaged 8.0% to 9.5% failures.

(*Kraus and Hirschland "Muscular Fitness and Health", Institute of Physical Medicine and Rehabilitation, New York University, Bellevue Medical Center.*)

Fourth—a report from the University of Pennsylvania by Dr. Elson and Dr. Huth reveals that only 13% of 1,000 apparently normal people examined were entirely free from physical defects.

Fifth—it is estimated that more than 10 million people in the United States today suffer from diseases under the group called collagen diseases. These include: (A) arthralgias; (B) erythematous or purpuric skin lesions; (C) visceral lesions, especially of the heart, and kidneys.

(*Journal of the American Medical Association, January* 8, 1955.)

Sixth—our cancer risk is great and the rate is growing. It is estimated that nearly one-third of all Americans now living will probably develop cancer before they die.

Seventh—31.4% of draftees or one of three men of draft age were rejected during the Korean conflict for physical defects. This figure was compiled after the physical requirements had been lowered following World War II.

Eighth—middle age for the average American male today begins at 26 years of age, according to the Research Laboratory on Fatigue at the University of Illinois.

(*Columbia Broadcasting television report February* 13, 1955)

There you have the statistical facts as to the status of our physical fitness today. And these facts do not include the economic care of the incapacitated nor do they attempt to picture the psychological and emotional problems faced by the victims as well as their families and friends.

By the way of contrast with this deplorable picture, is a report made by Dr. Robert McCarrison on the Hunza people of Northern India. Dr. McCarrison called them "A group of people unsurpassed in health and physical endurance." To confirm his observation, he ran a feeding test on rats, giving them the same type of food eaten by the Hunza people. These rats lived and reproduced healthy litters for generations without evidence of disease. Autopsies of the animals revealed no pathology of any of the organs. A control group of rats fed on diets similar to

those eaten by the average American or English human developed pathology in nearly all these organs.

We are all familiar with a more recent feeding test with cats made by Dr. Francis Pottenger, Jr., a member of the Academy of Nutrition. When the cats were given proper nutrition, the same excellent results as Dr. McCarrison's were achieved. These tests on rats and cats plus the present extensive research on liver diseases and atherosclerosis and related complications strongly confirm the close relationship of nutrition to degenerative diseases.

I believe that it was Dr. McCarrison who said, "The greatest single factor in the maintenance of good health is perfectly constituted foods."

Faced with this conclusion and factual evidence, it is readily apparent that we need to take a *new look* at our food consumption in relation to its nutritional quality rather than its quantity.

I agree with Dr. James W. Carson, our past president, who said that . . . "human nutrition demands a unity of theory and practice." We must use our scientific and technological knowledge to develop and produce foods that contain the essential nutritive elements. This can be done if we keep our minds directed toward the end result—optimum health—instead of toward short-range economics.

In past years, research in the field of nutrition has advanced rapidly and the scientists have given us much information on the action of nutrition and chemistry of the body and cellular functions. This scientific endeavor to increase our knowledge of nutrition is necessary if we are to penetrate the unknown frontiers of body metabolism.

In the field of clinical nutrition, we are aware of the symptoms outlined in the foregoing remarks. We must do something about them *now* and start the best nutritional therapy that is available, with the hope that scientists will give us more information about its physiological action later. In nutrition, we must rely on the principle of wholeness and the use of complete foods. There is a grave risk involved in the policy of fragmentation and substitution.

Food of high quality and wholeness means that the diet must be complete in all essential elements. There can be no substitution. Any alteration of any one of these essential nutritive factors, by removal or processing in their preparation, will in time produce changes in the architecture of the tissues.

It has recently been shown that withholding of one of the amino acids from the meal for only a period of three hours will interfere with the normal protein metabolism of the body.

Such findings reveal the delicate balance of the chemical and enzymatic action in body metabolism. All the essential elements of the body for ideal nutrition must be in harmonious balance and ready for immediate utilization. There also must be a certain amount of fresh raw food which retains the active life forces, or whatever one wishes to call that radiant energy present in fresh living food. Without that radiant energy, the human body cannot long survive.

How can we obtain this quality food? Unfortunately, there is no official standard for the nutritional quality of food today. It is judged only by its size, appearance and taste.

It is also unfortunate that many physicians in positions of influence do not understand the need for the soil ingredients necessary to grow quality foods. In an editorial in the Journal of the American Medical Association, issue of February 5, 1955, entitled "Common Sense Versus Food Fadism," it is stated that: "Another bugaboo is the assumption that vegetables from an unknown source were probably raised on soil depleted of necessary minerals and vitamins and are therefore nutritionally inferior, if not valueless. The fact is that, soil so poor would produce so meager a crop as to be negligible as a source of supply." This is contrary to a report from the U. S. Plant, Soil and Nutrition Laboratory, which pointed out that some of the principle vegetable and fruit growing regions of our Eastern Seaboard are so deficient in essential minerals that the actual nutrition value of the "protective" foods which they supply to our cities may be questionable.

Sufficient evidence is available from the reports of Dr. William Albrecht, and others that foods grown on depleted soil are not only deficient in certain minerals and low in vitamins but also deficient in high quality proteins. It has been shown by feeding tests that such depleted food will cause degenerative diseases in cattle as well as physical deformities in the offspring. This confirms the adage—"Healthy soil produces healthy crops, and healthy crops produce healthy people."

How does this influence our health today? Analysis of the soil in the United States reveals that only the prairie states or mid-continental area have the mineral ingredients necessary to produce high quality protein. This means that approximately

FEED FORMULA — STARTING

Amt. lbs.	Ingredients	%	Protein	Fat	Fiber	Calcium	Phosphorus	Vita.
1020	Ground Yellow Corn	8.5	86.7	38.8	20.4	.20	2.75	1,535,0
100	Oats	12.0	12.0	4.6	11.0	.10	.35	—
300	Ground Wheat	10.0	30.0	6.0	7.8	.15	1.20	—
100	Dried Skim Milk Powder		34.0	1.2	—	1.30	1.00	—
400	Menhaden Fish Meal (deh)		240.0	20.0	12.0	20.00	14.00	—
50	Alfalfa Meal		8.5	1.0	13.5	.75	.10	5,000,0
2½	Iodized Salt		—	—	—	—	—	—
2	Vitamin A—Dry		—	—	—	—	—	2,720,0
1	Vita. D—Activated Sterol .	40%	—	—	—	—	—	—
⅔	Manganese Sulphate		—	—	—	—	—	—
2	No. 86 Vitamin Mix		—	—	—	—	—	—
20	Ground Oystershell (fine) .		—	—	—	6.60	—	—
½	Vitamin E—10 grams		—	—	—	—	—	—
2	25% Choline Chloride		—	—	—	—	—	—
2000⅔	TOTAL		411.2 lbs.	71.6	64.7	29.10	19.40	9,250,00
	Analysis Per lb.		20.6%	3.6%	3.2%	1.46%	.97%	4,62
	Requirements Cornell U. ..		20.5%	3.5%	3.5%	1.2%	.6 %	3,00

FEED FORMULA — ALL MASH

Amt. lbs.	Ingredients	%	Protein	Fat	Fiber	Calcium	Phosphorus	Vita
1050	Ground Yellow Corn	8.5	88.8	39.7	20.9	.21	2.82	1,567,
150	Oats	12.0	18.0	6.7	16.5	.15	.53	—
450	Ground Wheat	10.0	45.0	9.0	12.6	.23	1.80	—
100	Dry Skim Milk Powder ...		34.0	1.2	.2	1.30	1.03	—
227	Menhaden Fish Meal (deh)		136.2	11.4	6.8	11.35	7.95	—
50	Alfalfa Meal		8.5	1.0	13.5	.75	.10	5,000,
30	Steamed Bone Meal		1.5	.6	1.2	9.52	4.20	—
40	Ground Oystershell (fine) .	40%	—	—	—	13.20	—	—
5	Iodized Salt		—	—	—	—	—	—
2	Vitamin A—Dry		—	—	—	—	—	2,724
1	Vita. D—Activated Sterol .		—	—	—	—	—	—
⅔	Manganese Sulphate		—	—	—	—	—	—
2105⅔	TOTAL		332.0 lbs.	69.6	71.7	36.71	18.43	9,291
	Analysis Per lb.		15.8%	3.3%	3.4%	1.75%	.88%	4
	Requirements Cornell U. ..		16.0%			1.80%	.75%	3

RTING MASH — FEED UP TO 8 WEEKS

Vita. B Complex

Vita. A	Vita. D	Riboflavin	Niacin	Panothenic Acid	Choline	Manganese	Calories
1,535,000	—	510	10,200	2,142	204,000	2,652	1,167,900
—	—	60	650	450	42,000	1,990	76,000
—	—	150	7,800	1,500	135,000	5,970	306,000
—	—	950	600	1,500	50,000	80	52,500
—	—	1,400	10,000	1,600	480,000	4,080	360,000
5,000,000	11,250	335	850	870	22,500	1,000	13,050
—	—	—	—	—	—	—	—
2,720,000	—	—	—	—	—	—	—
—	1,360,800	—	—	—	—	—	—
—	—	—	—	—	—	87,000	—
—	—	4,000	20,000	4,000	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	196,840	—	—
9,250,000 Units	1,372,050	7,405 mg.	50,100	12,062	1,130,340	102,772	1,975,450 Calories
4,625 Units	686 Units	3.7 mg.	25 mg.	6.0 mg.	565 mg.	51.5 mg.	988 Calories
3,000 Units	380 Units	3.0 mg.	25 mg.	6.5 mg.	500 mg.	28 mg.	

"Feedstuffs" July 16th, 1955, Prof. Combs, University of Maryland

MASH LAYING — FEED AFTER 12 WEEKS

Vita. B Complex

Vita. A	Vita. D	Riboflavin	Niacin	Panothenic Acid	Choline	Manganese	Calories
1,567,000	—	523	10,450	2,195	209,000	2,717	1,196,525
—	—	90	980	675	63,000	3,000	116,000
—	—	225	12,000	2,250	200,000	8,600	460,000
—	—	950	620	1,560	61,200	80	52,500
—	—	794	5,675	908	272,400	2,315	223,141
5,000,000	11,250	335	850	870	22,500	1,000	13,050
—	—	15	69	30	—	—	9,000
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
2,724,000	—	—	—	—	—	—	—
—	1,362,000	—	—	—	—	—	—
—	—	—	—	—	—	87,000	—
9,291,500 Units	1,373,250	2,932 mg.	30,644	8,488	828,100	104,712	2,070,200 Calories
4,646 Units	687 Units	1.4 mg.	14.6 mg.	4.0 mg.	394.0 mg.	49.4 mg.	986 Calories
3,500 Units	500 Units	1.5 mg.		4.7 mg.		15.0 mg.	

two-thirds of our soil is deficient in minerals and organic matter and is not fertile. Dr. E. E. Pfeiffer, soil analyst, estimates that the average organic content of our soils today is only 1.5%. This is the critical level below which the soil is no longer fertile. When the organic matter disappears, the soil becomes a desert.

Add to this low quality food the following defects and the picture becomes even more discouraging:

ONE: Further depletion of this low quality food by refinement and processing, removing essential vitamins and minerals.

TWO: There is a residue on all foods of toxic chemical insecticides. The Public Health Service reports—"No meal was found either in the restaurants or in the institutions which failed to contain some DDT". We are all familiar with its accumulative action in the body fat and its toxic effects on the liver and nervous system.

THREE: The continued extensive use of carcinogenic dyes for color control of certain foods for appearance.

FOUR: The addition of stilbestrol and anti-biotics to the feed of the animals used for human consumption I feel has not had sufficient long range nutritional studies.

FIVE: Surveys reveal that approximately 50% of the people in the United States do not eat the correct food, as shown by the following-imbalanced nutritional pattern.

Overconsumption of fats and carbohydrates which has resulted in 32 million over-weight people.

National sugar consumption is 100 pounds per year per person or an average of 500 calories per day. Since it requires 1.5 milligrams of thiamine and riboflavin to metabolize 1,000 calories from sugar this leaves a deficiency of about 0.5 milligrams of both thiamine and riboflavin per day. Consider how this accumulates and interferes with the enzyme system of metabolism, the end result is the production of toxic metabolites. Tests have shown that incomplete metabolism of carbohydrates interferes with cellular metabolism which results in the death of cells. This is the beginning of tissue pathology.

The prospects for good health today and in the future under the present nutritional picture cannot, by any stretch of the imagination, be called good. We are paying a high price for having forgotten that we humans are an integral part of nature. A business man would hesitate to invest money in such a declining business unless he had the financial aid and concrete ideas for a complete re-organization.

I believe that we can all agree there is a great and urgent need for a re-appraisal of the nutritional problem.

Dr. Granville Knight, president of the academy, has written to President Eisenhower and other government officials and organizations, pointing out this critical situation. The academy of nutrition has outlined and supports a dynamic approach to a positive plan for reconstruction of our nutritional problems.

The academy as a non-profit organization, needs and requires greater financial support in order to activate and expand the present educational and research program in applied nutrition.

It's now doing excellent work locally here in California in the public school in teaching the young people the basic principles of good health through nutrition. These results can be seen by the response of the children in participating in the "Nutrition Fair".

This type of education program should be expanded to a national scale. It may even be able to penetrate into hospital nutrition which is notorious for its deficiencies.

FIRST: A more extensive educational program should be undertaken.

SECOND: There is a vital need for better soil fertilization. We should advocate the use of new technical methods of producing better fertilizer from organic waste and garbage. The destruction of millions of tons of garbage should be discontinued, and the garbage returned to the soil from whence it came, to maintain a living organic fertile top soil. Several plans for this are now under investigation and some are in actual use. The plan, of course, should also include the replacement of trace minerals.

It has been found that fertile soil and healthy plants reduce the necessity of using the poisonous chemical sprays. If we can make the H-bomb, we certainly should be able to raise high quality food without chemical residue. It is far from good economy to subject the entire population to the long-range effects of accumulation of these chemicals in the body.

THIRD: We must help raise the standards of nutrition. Deterioration of the health of the people means a weak nation. We spend billions to protect our people from human enemies and allow our health to deteriorate before the enemy strikes. Higher nutritional standards for food sold in markets must be set and understood by the public. Quality food should have a standard

seal approved by an organization such as the Academy of Nutrition.

FOURTH: We should advocate a better farm program. Today, as we all know, the farmer is over-producing. Billions of dollars worth of surplus crops are stored in caves and warehouses. The government is paying subsidies to the farmer for over-producing low-quality food and further depleting his soil. Would it not be better if the government gave the farmer special assistance for soil conservation and the production of high quality food free of chemical residue? As this takes time some of the surplus crops could be used while the transition from over-production to quality production takes place.

FIFTH: We should sponsor a pilot sanitarium located on an organic farm where children or adults could be fed quality food grown on healthy soil, free from poisonous residue. The results of these tests could then be publicized to help prove the value of this type of nutrition.

The foregoing five points would, I believe, give us a national plan that would help the entire nutritional picture as we see it today.

It has been said that destiny has placed the United States in the position of world prestige and power. We have the wealth and the abundance of food. We have the power to make peace. But hungry people are not interested in politics. They are interested in food for survival. Food can be the basis of peace. The present plan of distributing our surplus food to our friends and allies who are in need should of course, be continued.

Granted—we have the organizations. We know the needs. We have the blue prints. But these do not feed hungry people. What is again needed is a bold, dynamic, and, if necessary, dramatic approach to the international situation.

The World Health Organization and the Food and Agricultural Organization are surveying the world health and nutritional problems and know the needs. However, Philip V. Cardon who was recently appointed director general of F. A. O. to establish a World Food Reserve, was given a meager budget of only $6,000,000. The F. A. O. motto is "Let there be Bread." This is as essential as military aid.

I believe that a small percentage of our government's military budget should be allocated for improving nutrition and health. In other words, set up an international peace pool, similar to the "Atoms for Peace". Call it "Food For Peace". Each

nation would then be invited to join the pool with a proportionate amount of their military budget. The psychological impact would be such that other nations on both sides of the iron curtain could not refuse to take part in such a positive action for peace.

It would be truly carrying out the biblical statement: "They shall beat their swords into plowshares, and their spears into pruning hooks: nation shall not lift up swords against nation, neither shall they learn war anymore."

B. D. CONFERENCE 1955

RENATE SCHAAFHAUSEN

Again this year, the Bio-Dynamic Conference was held at Threefold Farm, Spring Valley, N. Y. At these sessions people with the same basic aims meet annually to listen to lectures, and to bring their problems and questions to be discussed. This last factor gives the Conference a somewhat different character each time. Although there were many "opinions" expressed in the many discussion periods, at the end there was a very definite consensus of opinion on one thing that had run like a red line through the entire meeting, namely the need of putting our results on a scientific basis, in "figures and numbers", as Dr. Pfeiffer said, so there can be genuine comparisons and evaluations.

On Friday, July 29th, Dr. Pfeiffer opened the Conference with his talk on "Roots", a subject that currently occupies many scientists, for the facts on root "life" and its important role in plant growth are very little known and much less understood. When he said: no one ever has seen a complete plant root, everyone present felt almost insulted. But when he stated that including all the tiny root hairs, a four months old rye plant, grown in a fertile soil has, just before maturation, a total length of 387.17 miles, everybody seemed convinced that they really had *not* seen one yet.

A plant root has capacity for an unlimited growth, but if we consider our modern farmer who has to plow his fields, we realize that cultivating them limits the root-spreading of his plants. Dr. Pfeiffer compared the root's indefinite growth with the growing of a fish, which has been shown to have an unexplained, unlimited growth possibility. In trees, he said, the roots are still more interesting than in field plants, as the root

system is a copy of the tree above the ground. The root pattern of a cherry tree for instance has the shape of the cherry tree above.

A wild plant is always so much stronger than a cultivated plant, one only has to look at a weed to confirm this. It is partly due to the fact that in cultivating we clip off the most important part of the root of our domestic plants, therefore they need fertilizer. Yet as long as the plant lives, as long as favorable conditions prevail, the root is able to grow. What is the reason for that? What does the root do? It absorbs water and minerals, but at the same time it has a *limited* water absorption, it could drown if left in standing water. This factor is determined by the soil in which it grows. In this connection we have to study many different soils, for instance a humus soil only absorbs up to 46% water, a humus soil with a moisture content below 12% is no longer able to absorb water. A clay soil holds more water, its upper limit is 52%, its lower 8%, while a sandy soil only absorbs up to 20.8%. If a soil gets waterlogged, a plant cannot breathe; in a plant we observe respiration and assimilation, an excretion of carbon dioxide and assimilation of oxygen. If a root is not able to absorb oxygen it cannot breathe. These processes are regulated by light more than warmth.

The plant however, not only takes from the soil, but also gives back important nutrients. There is a constant exchange. The root excretes moisture, organic acids, carbon dioxide. It is extremely clever in analyzing its soil, for in an acid soil the oxygen intake is reduced, while in an alkaline soil we have an increase of oxygen intake, provided there is enough water. The more acid a soil is, the less well-nourished the plants are. The humus and organic matter content of a soil have a definite influence on the metabolism of the roots. In order to grow roots in the right way, Dr. Pfeiffer concluded, we must find the proper balance to that which we do wrong to them. Overfertilization is not the answer, but is one of the causes that upset this balance.

In the evening of the same day, Mr. Rudi Schoenbeck gave a report on the Pfeiffer Farm in Chester, N. Y.; a dairy farm operated on B. D. principles which he recently has rented and now operates himself. Starting with a Government Loan and very hard work, having practically no help at all, he managed to get along fine through the first months, which are generally the most difficult ones. Having worked on the farm for several years before, he for one thing had the advantage of knowing his

soils, while many a farmer who takes over a new farm first has a struggle to find out the particular needs of his soils. He very clearly pointed out, that today, making a living for a family does not entirely depend on the farmer's efficiency, but also on factors stemming from our economy, which at present has nothing else in mind but to exploit the productivity of our agricultural land. Fundamentally, our material way of thinking which has separated us from nature will be the major handicap in solving this problem. Mr. Schoenbeck mentioned that in 1946/47 seven cows were sufficient to support a family while this year thirty cows is the minimum to achieve the same end.

The next day started with a report given by Mr. Walter Stuber on Golden Acres Farm, presently the largest B. D. farm in America, which is highly mechanized and has a maximum production with minimum labor. Mr. Stuber mainly reported on the new chicken farm, which was recently established. This report appears elsewhere in the present number of Bio-Dynamics.

Dr. Pfeiffer's second lecture dealt with the problem of "Scientific Composting". The scientific point of view is an absolute necessity. Compost is fermented organic matter which in the end becomes stable humus. Its variability is quite great. To apply compost to the land you also have to know the compost's value, in the same way as one knows the NPK formula of a mineral fertilizer. In building a compost pile as the farmer and gardener does one has especially to observe the moisture content, which is best at 40 to 50%; above all one should keep track of the pH level. The pH of a digested material should be alkaline, if it is acid we have a yeast fermentation which is certainly not favorable. The moisture content determines the type of microlife. In a compost with 80% moisture we have anaerobic conditions, a loss of nitrogen and an increased carbonization but no humus. The compost is considered dead, it has no bacterial life and will not absorb water. The other extreme is a compost with a moisture content of 12% or less, which is dead also. This latter is the case with a dehydrated product.

Again and again we have heard a lot about composts, but there is never a limit to what one can learn about them. Dr. Pfeiffer again pointed out, that unless one knows the analysis of the material to be applied to the soil, one will not know of the effect it will have and one is apt to have unwanted surprises. If the compost is applied on a scientific basis this cannot happen. He went on to say that the high percentages in an inorganic

fertilizer formula are of little use. Nitrogen in an organic compound is four times as effective as in a mineral compound. A compost with 1.7% to 2% Nitrogen content applied to the soil retains a stable nitrogen content, with a higher formula it becomes unstable, ammonia is set free and nitrogen lost. To sum up: not the quantity of a compost to be added to a field is important, but the quality.

At the Annual Meeting of the Bio-Dynamic Farming and Gardening Association, in the afternoon, the minutes of last year's meeting were read by the Secretary-Treasurer, Evelyn Speiden, and approved by the members. This meeting was followed by another of the discussion periods that were scattered throughout the Conference.

In the afternoon of the same day the Misses Spock and Richards gave an enthusiastic report on their own little enterprise; cultivating a 2 acre woodland area and having "surprising" results in the first year of production. It was illustrated in lively fashion by Miss Spock, telling how they with their own hands worked in and with the soil, learning all the time from the mistakes they made and didn't make. One thing they knew and observed carefully from the start was, that one should *never* start gardening the first year after clearing new land. It has to be prepared first. Everybody enjoyed the enthusiasm with which Miss Spock pictured their efforts to make this garden a success. Their report will appear in Winter issue.

In the evening Evelyn Speiden gave an informative lecture on "New Aspects in Vegetable Gardening". An article developed from her lecture will appear later.

Dr. Pfeiffer's third lecture, given on the last day of the conference, dealt with the problem of "Present Farming Methods and their Survival in our Economy", readers are referred to the current article by Dr. Pfeiffer.

In the afternoon there was a visit to the Biochemical Research Laboratory where Dr. Pfeiffer, as in previous years, spoke about the latest developments and about the necessary bacterial action in a soil or compost. He told of how this is brought about by spraying the B. D. Field Spray over green manure crops for instance, just before disking them under, to speed up the decomposition and make the soil ready sooner for the new seeds to be sown. He also spoke about the latest research being done, telling among other things, how one is able to differentiate between a "humus compost" and a "mineralized"

one, by way of Chromatography where a chemical analysis would fail to show any difference.

Last but not least the Conference was concluded with a Eurythmy Performance directed by Lisa Monges, which everyone present enjoyed very much. The eurythmists taking part were: Ruth Linder, Mrs. Monges, Ruth Pusch, Hanni Schlaefli, Kari van Oordt, and Students. Bettina Kroth and Howland Vibber did the recitation. Norman Vogel, who composed the music for one of the numbers, was at the piano, and Mrs. Imrè Kovacs played the violin.

POULTRY OPERATION AT GOLDEN ACRES FARM

WALTER STUBER

About nine years ago I got into the chicken business, so to say, by accident. I had then only the Dairy Farm; but since I was always out to provide for our help as much free home grown food as possible, I bought about 40 laying hens to fill the egg and stewing chicken needs of the farm population. This worked out nicely, except that the chicken feed and other expenses resulted in a yearly loss of $250. It was then, that I decided to turn this loss into a profit, and did so by increasing the flock to 300-400 chickens. The situation took such a pleasing turn that I set my mind on a full size chicken operation. Just at the time (1951) an adjacent farm of 125 acres was for sale; and in 1952 we were in the chicken business, gradually, now in 1955 reaching our maximum of about 4000 laying hens plus the necessary pullets for replacement.

We started out with Rhode Island Reds and were satisfied. But after talking to various poultry men, we finally wanted to try for ourselves to see whether there would be an advantage in switching to White Leghorns. We had Leghorns for one year and did not have too happy an experience. These birds are highly bred and are very nervous, and easy victims of diseases — at least this was our experience. Now we are back to Rhode Island Reds and are very happy with the change.

The living quarters of our chickens consist of a very old barn, which I converted into a three story chicken house. We have seven pens, four holding approximately 400 each, two holding 700 each and one holding 850 chickens. The roosts, terminating at one end of the building at a large door, are located in the center of the pens. They are hinged at the sides and can be folded open in the center, thereby enabling a tractor to drive

through when time for cleaning comes, which is three times a year. The litter itself is changed once a year.

The lights in the laying pens go on and off automatically—on in the morning at 3 o'clock, in the evening off at 8 o'clock. However, in the evening as the lights go off, a few pilot lights go on directly over the roosts, in order to attract the chickens to sleep on the roosts during the night.

We found that Rhode Island Reds prefer community nests, whereas Leghorns prefer the open type nest.

We have Buckeye automatic feeders—one large one and two small ones taking care of all the chickens. The feeders get loaded once every morning. Drinking water is also provided automatically by automatic drinking fountains.

Ventilation is taken care of by a ventilator installed on the roof, sucking air through a duct which runs from the roof down to the first story. The suction outlets in each laying pen are placed in the wall a little above floor level; thereby keeping our litter always dry.

We always buy our chickens one day old and keep them under gas brooders, each brooder taking care of 200-250 chickens.

The first six weeks we give Camomile Tea once or twice a week in the drinking water, for prevention of Coccidiosis. On the ninth day, provided the chicken is in good physical condition, we vaccinate against Newcastle Disease by injection in the breast. In the 12th week we vaccinate against Foul Pox and take the chickens on the range, where we provide range shelters housing 250 birds each. At the age of 5 to 6 months, the chickens are brought to the laying pen and at the same time vaccinated a second time against Newcastle Disease by injection in the wing.

About a week after housing, we treat the chickens preventively against Bluecomb or Pullet Disease by adding Terramycin to the feed for a few days.

And now, the chickens are ready for 12 months of continuous laying. After that time we cull the flock and keep the good birds for an additional six months of laying, though a certain amount of culling takes place throughout the year. When the chickens are two years old, they are sold and replaced by a new flock of five to six months old pullets.

Our egg production, graded on an Eggomatic Grader, is put up in cardboard containers holding 30 dozen eggs each and brought weekly (in summer bi-weekly) to the nearby Egg auction, where we also sell the old chickens.

Our feed formula I made up myself in cooperation with the Farm Bureau, since we feel that most ready formulas are too far away from what we believe is a natural feed. Composition of our formula as well as use of Starting Mash and All Mash Laying Mix can be seen in the Feed Charts below. Right now I am working on one addition to the chicken feed—earthworms, trying to raise enough of them to supply all the chickens.

We have our own hammer mill and mixer for preparing our home grown feed. In moving grain, no lifting is done by hand. From the combine in the field, the grain is moved by auger into a tank wagon, from where it is moved by auger to the grain bins and again, from the bins to the hammer mill, it is moved by auger.

For the first time we will, this fall, have a similar arrangement with the corn. We intend to rent a Minneapolis-Moline Corn-Combine, which picks, husks and shells the corn right in the field and drops it into a Standard Drying Wagon to bring the moisture down to 12%. This saves the rehandling of the corn for shelling later on and also allows us to take it off the field in ample time to plant wheat.

We grow all our necessary grains and corn on about 120 acres of cultivated land, buying only the necessary concentrates.

The chicken manure we mix with large qualities of straw, of which we have more than enough, and treat it with the Bio-Dynamic Starter, thereby getting excellent compost. Our farm operates fully along the Bio-Dynamic principle, and we are highly pleased with its results. In addition to setting up long rows of compost, we make full use of the Bio-Dynamic Sprays 500 and 501. We take care in selecting our crop rotation, and add a green manuring crop whenever possible.

This whole operation here described is taken care of by three persons.

Here follow our feed formulas, which may be of interest to other chicken growers among the readers of "Bio-Dynamics".

Editor's Note: Mr. Stuber's formulas for Starting Mash and for Laying Mash are folded, loose, into this issue as an insert for the convenience of readers. Consult these first, and then continue with the tables printed below.

The *Growing Mash,* a blend of the Starting Mash and the Laying Mash, is an interim feed given in the proportions listed in the following table:

		Starter	All Mash Laying
9th Week:	Mix and Feed	1,500 lbs. with	500 lbs.
10th Week:	Mix and Feed	1,000 lbs. with	1,000 lbs.
11th Week:	Mix and Feed	500 lbs. with	1,500 lbs.
12th Week:	Mix and Feed	250 lbs. with	1,750 lbs.

Scratch Feed for the younger birds is held out from the Starting Mash mixture before this is ground into mash:

400 lbs. ground corn
50 lbs. oats
100 lbs. ground wheat
200 lbs. concentrate

750 lbs.—One Batch (capacity of our mixer)

Scratch Feed for the layers is, in turn, held out from the All Mash Laying mixture after it is mixed but before grinding, as the following table shows:

350 lbs. ground corn
150 lbs. ground wheat
50 lbs. oats
150 lbs. concentrate

700 lbs.—One Batch (capacity of our mixer)
Feed September to April Scratch Feed 4 lbs. per 100 birds per day; for purpose of keeping litter loose and dry, i.e. for 3500 birds keep out of each batch 80 lbs. for Scratch Feed.
30 lbs. All Mash per 100 birds (R. I.) per day.

OBSERVING ROOT HAIRS

Most of the "discussion" items at a B. D. Conference necessarily go unreported in the stories of these meetings. When Dr. Pfeiffer, as told in the foregoing article, lectured on "Roots" and spoke of the tremendous footage of root hairs that help make our garden vegetables, grains etc., grow, a staunch B. D. enthusiast from of old, Mrs. Louis L. Browne of Sewickley, Pa., later described a simple way by which the amateur can see these root hairs for himself. Ordinarily one might, unless one is a scientist, hardly realize their existence since most if not all of these very fine growths remain in the soil. So the editors asked Mrs. Browne to write out what she had done with regard to getting a more first-hand idea of what goes on. Mrs. Browne suggests:

Have two pieces of glass and a colored blotter about the same size. Place the blotter on one piece of glass. Put several squash or pumpkin seeds on the blotter and lay the other glass over the seeds. Then hold all together with an elastic, which will keep the seeds in position and yet give them enough freedom to grow. Dip one edge of the contraption in water so the blotter can carry moisture up to the seeds. In a few days roots will appear and can be watched, while developing, through the upper glass. Where the root hairs appear you will surely get a thrill, and a realization of what Dr. Pfeiffer told us went on under the ground.

GREENHOUSE EXPERIENCES—Conclusion

HELEN PHILBRICK

With the help of several books, seed catalogues and the Missouri State College of Agriculture planting suggestions from our County Agent, we have evolved some planting dates for seeds for the summer vegetable garden. However, our own records kept from year to year are more valuable than all the theoretical suggestions because they take into account all the individual conditions present in this house. The first year we planted too early. The next year tomato seeds were sown too late. This season we should correct both errors. A schedule of dates can only be evolved after several years of experience with varying weather conditions.

As the spring advances and tiny seedlings require additional space and nourishment they must be pricked out in flats or pots. With limited space, we prefer to use wood veneer plant bands to either flats or pots. Flats are unwieldy to handle, heavy, and too large to move easily. However, if one has plenty of space, they enable one to move many seedlings at once. We have tried three inch clay pots and three inch plant bands — which take up the same amount of bench space. The plant bands are preferable because 1) they pack together in a solid block with less chance for evaporation, 2) the shape of the plant band (a cube) presents a solid cube of soil for the plant roots to spread in. 3) the plant band, if made of wood (not tar paper) can be set directly in the garden bed without removing the roots from the container. Clay pots leave much space around them for evaporation. Seedlings must be removed from clay pots before planting, sometimes injuring tender roots. Clay pots have to be collected, cleaned and stored away for next year's use. However, when clay pots are purchased, there is only one investment. Veneer plant bands may be collected and save for use next year, but they are rather fragile and are easily broken. We tried tar paper plant bands which the man in the store assured us would be completely satisfactory. Some of the tar paper bands left in the ground year before last are still intact. Even in the compost heap they refuse to decompose. Veneer plant bands are somewhat hard to find. The only seed company in the middle west which handles them is Burgess Seed Company, Galesburg, Michigan. They cost about one cent apiece.

Small seedlings whether in greenhouse or outdoors require close watching for they must be watered and transplanted at exactly the right time. This one learns to know only by observation. Too much sunshine or draft or water can be as disastrous as too little. Therefore anyone trying to raise seedlings in greenhouse or coldframe should be counseled to be ready to give them steady attention.

No matter how much we anticipate needs and eventualities, there are always unexpected problems to solve. When our greenhouse was built, it seemed reasonable that two small windows on hinges in the outdoor end would provide sufficient ventilation. In the cold weather these doors can be open only a crack, held by a storm window bracket which can be screwed tight at any position. In hot weather we take the doors off altogether — rather they were taken off for us when the wind blew hard all night and wore the hinges until they broke. Next time we will use heavier hinges. We hope sometime to contrive an additional ventilator in the glass roof.

Another problem we should have anticipated was the excessive spring and summer heat under glass. As early as mid-April the sun over Missouri develops a fierce intensity which must be softened under the glass or it will bake every seedling in a few hours. For two years we laboriously tacked cheese cloth up on the greenhouse ceiling, dropping thumbtacks into the plant flats and winding cheesecloth around the hanging plants. The first year the sweet peas grew above the cheesecloth until they were scorched on the hot, steamy glass and finally pushed out the thumbtacks. Last year the grasshoppers chewed holes in the cheesecloth, letting the hot sun through the holes. This spring the old cheesecloth was too dilapidated to use again. But the need was desperate and there was no time to go to a library to look up paint for greenhouse sash. One of our old books recommended a paste made of flour and water. This we painted on the glass on the outside. It works well. We experimented with both cold paste and boiled paste and found that the latter sticks better but the cold paste is more opaque. In a driving rain some of the paste will wash off but it is easily replaced. Or thin places may be retouched with a few coats of newly made paste. The cost is practically nothing.

Shortly after we had painted the entire south exposure with paste, mildew began to grow on the plants inside. We washed a strip of glass panes clean again in a vertical line so that the sun

now shines directly on every plant in the house for a little while each day. Plants like thyme which need hot dry sunshine we placed near the south edge of the bench and cleaned the panes beside them so that they too get direct sunshine through clear glass all day long.

It was a surprise to us to observe that the sun shines on the north side of the greenhouse with almost as much intensity as on the south. We have also painted the north half of the gable with flour paste with the exception of the lowest row of panes which admit the sun's rays very obliquely in springtime, and even less directly in the hottest part of the summer.

Lest anyone should think that this greenhouse is too fancy for the usual household, we would assure him that this could easily be made in any house with a suitable exit from basement. This exit could be on the east, south, or even on the west provided the glass structure could be built to catch the sunshine from the south most of the day. Early morning sunshine seems to be especially beneficial too, if it is possible to get it. We built a very makeshift greenhouse with south and west exposure in another house here in Missouri by framing it with 2 x 4's and glassing it in with old windows on the south side and west end. Although this had a wooden roof and was shaded in summer by a mulberry tree, we raised many seedlings there with only an electric-steam radiator for heat (robbed from the bath room). On cold nights we covered everything with newspapers, opened the window between the living room and the greenhouse and hoped the mercury would not go too low. One frantic night I recall bringing all the tender plants back into the living room, because there was a frost warning. The cost of that makeshift greenhouse was the expense of some cement blocks for foundation, the 2 x 4's for frame and some roofing paper to cover the old lumber we used for the roof. The windows came from some torn down barracks and we are still using them for cold frames.

The cold frame is almost a necessity in conjunction with the greenhouse for hardening off seedlings and for managing the overcrowding which is inevitable at certain times in the growing season. Our coldframes are covered with glass sash and banked with straw and horse manure to keep out the cold winds. Very early in April the glass windows must be raised every day because the sun gets so hot and the seedlings get tender and leggy. At night the sashes must be lowered to keep the cold wind off

the seedlings. In May the sash must be removed altogether lest the plants collapse in the heat.

It seems as though we take off the glass windows one day and need shades against the violent summer sunshine the very next day. We built lath shades which are light enough to handle but which make a strip of shade alternating with a strip of sunshine over the cold frames all day. Parsley thrives under this semi-shade as does lettuce and other herb plants.

The interrelation of plants, atmosphere, soil, light and moisture in the greenhouse or coldframe creates an entity which must be observed and studied as a whole. Similarly the greenhouse and coldframe are only two small parts of the entire Homestead. The greenhouse is fertilized by composted animal and poultry manures and garden wastes all produced here on this acre. In turn the greenhouse provides seedlings for vegetables, flowers and herb gardens, some of which are in turn fed back to the chickens and the milk goats. The greenhouse also has a close relationship to the houseplants which are a major interest in winter. Nor is even the rainbarrel left out of the cycle of interdependence. In fact, the demand for rainwater for houseplants, seedlings, greenhouse and BD sprays has been so great and the supply of rain so scant that we have brought the rainbarrel into the cellar for the winter, piping the water from the downspouts to save any rain that may fall while it is too cold to have the rainbarrel connected outdoors.

The books mentioned in the Bibliography have helped us over and over again. Until we have gained more first-hand experience we will still refer to these books. Needless to say the books on Bio-dynamics come first, including the magazine Bio-Dynamics. We have learned with modern American magazines to take with a grain of salt any article which makes such a statement as : "The greenhouse is about the easiest thing to care for on the place." It is our experience that any project that is worth doing will require a great deal of steady thoughtful attention with patient observation and careful records. In other words, although we are both completely "sold" on the small, cold greenhouse, we do not want this to sound like a "glamour article" because it takes a lot of sustained effort and routine hard work.

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